Reticle schematic

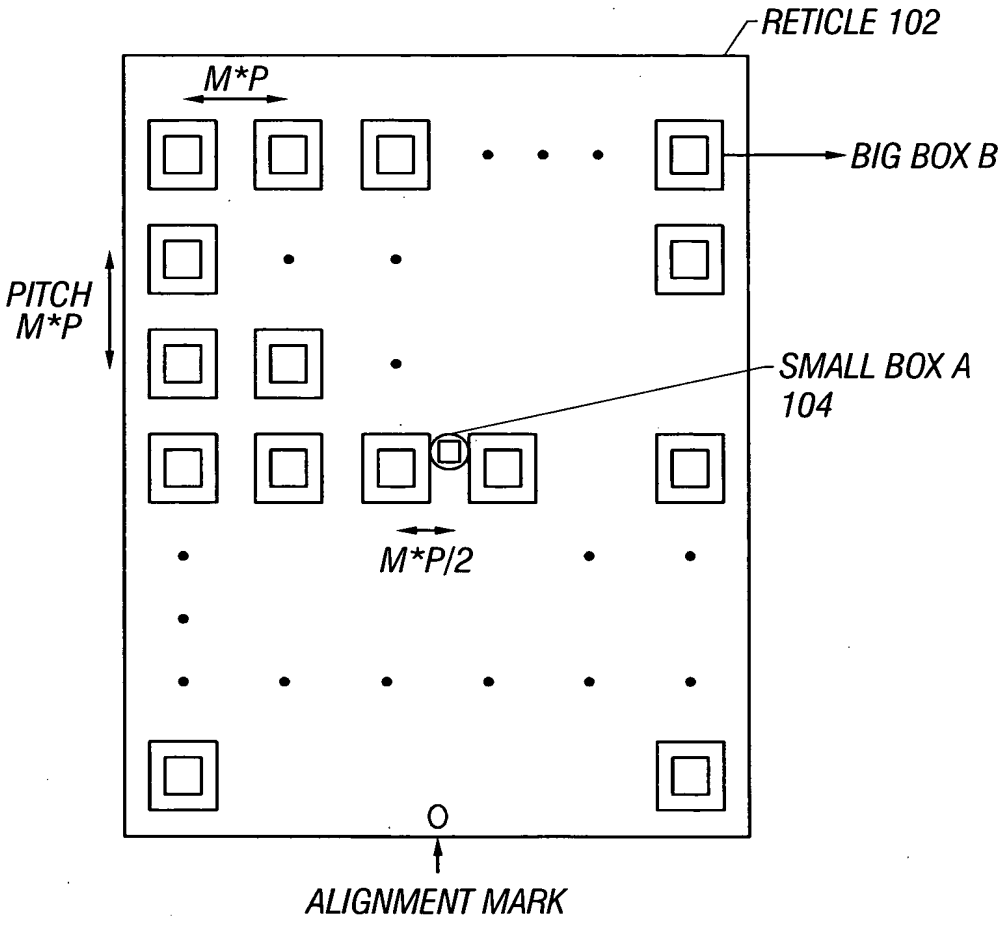


FIG. 1

Schematics for FIG. 1

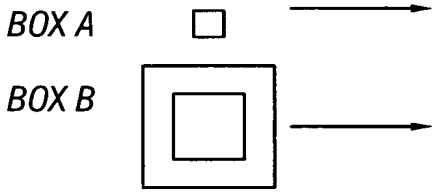


FIG. 2

Reticle Features

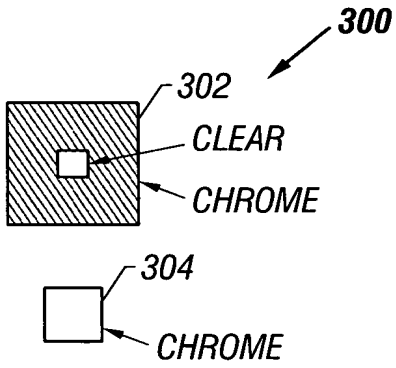


FIG. 3

Overlapping regions

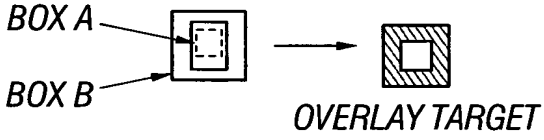


FIG. 4

Perfectly centered Box-in-Box structure

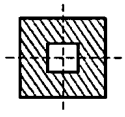


FIG. 4A

Schematic for outer box 2

FIG. 5

Schematic for inner box 1

FIG. 7

Schematic for 2-dimensional 4XOL reticle

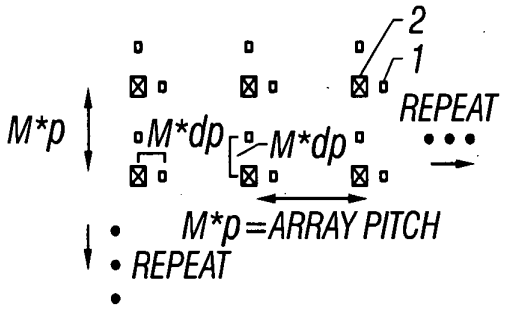


FIG. 9

Outer box 2 as printed on wafer.
Dark=unexposed, white=exposed

FIG. 6

Inner box 1 as printed on wafer.
Dark=unexposed, white=exposed

FIG. 8

Typical 4XOL reticle overlay set as projected onto wafer (3 featured parts); dark=unexposed, white=exposed

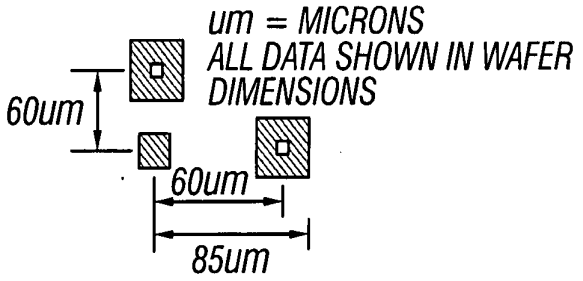


FIG. 10

Heller Ehrman White & McAuliffe LLP
Title: "METHOD AND APPARATUS FOR SELF-REFERENCED PROJECTION LENS DISTORTION MAPPING"
Inventor(s): A. Smith et al.
Atty Docket No.: 38203-6080C
Application No.: 10/727,018 - Filed: 12/02/2003
3/31

Schematic of X-shear overlay on wafer

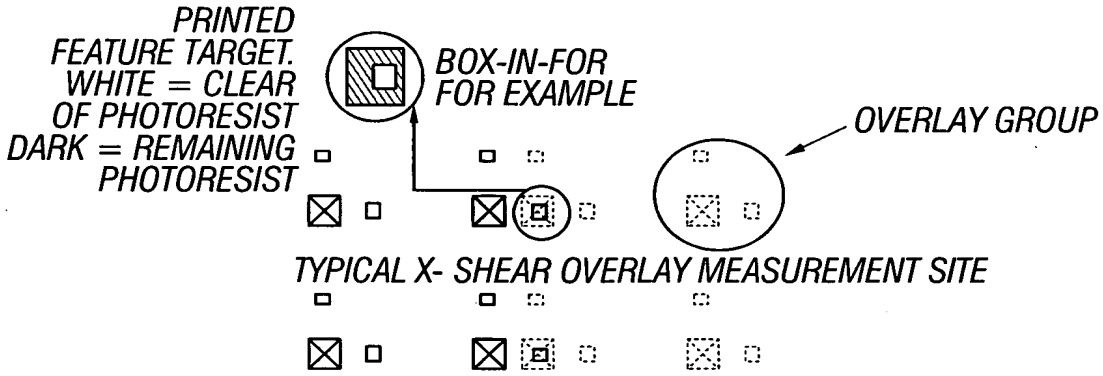


FIG. 11

Schematic of Y-shear overlay on wafer

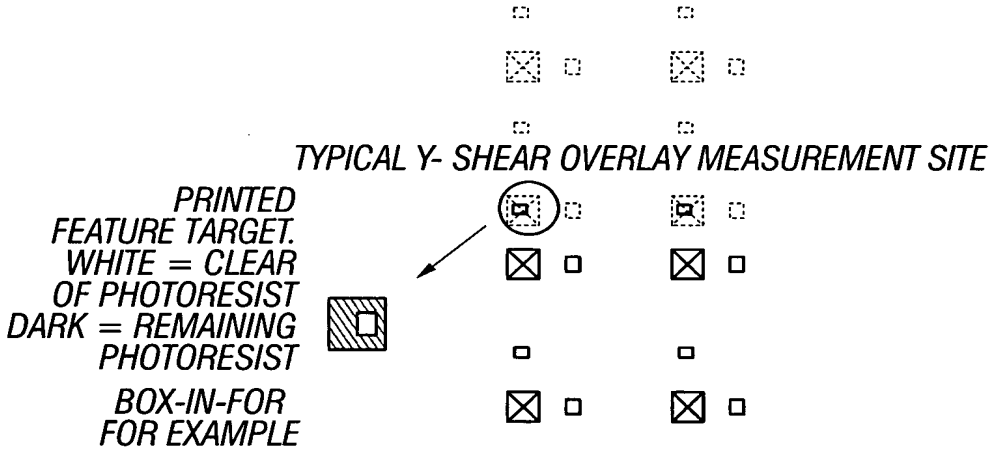


FIG. 12

2-Dimensional reticle schematic, 90 degree overlay or R-shear.

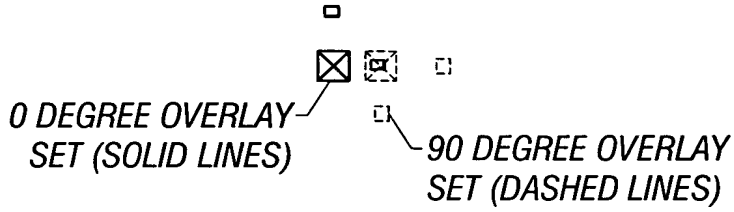


FIG. 13

Typical overlay patterns or completed alignment attributes

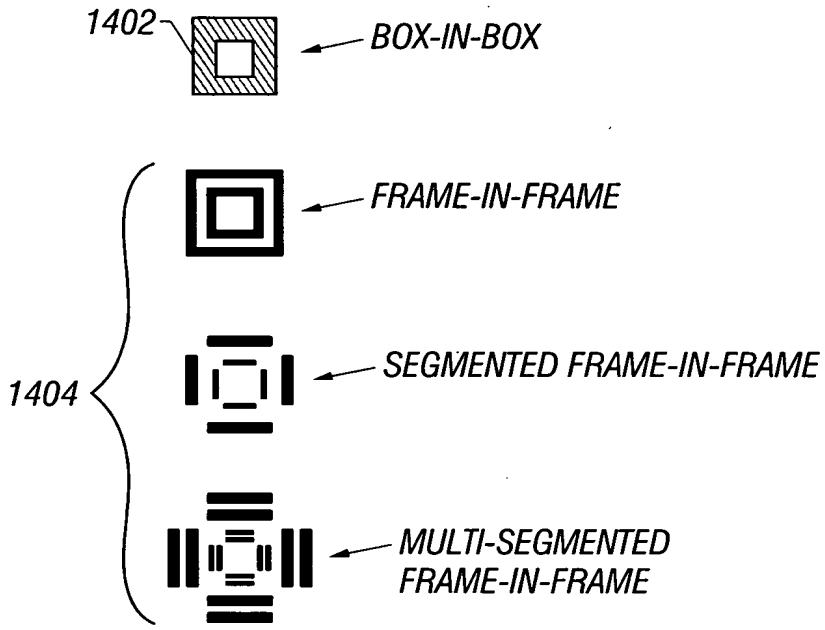


FIG. 14

Process-flow for the second embodiment for self-referencing lens distortion measurement.

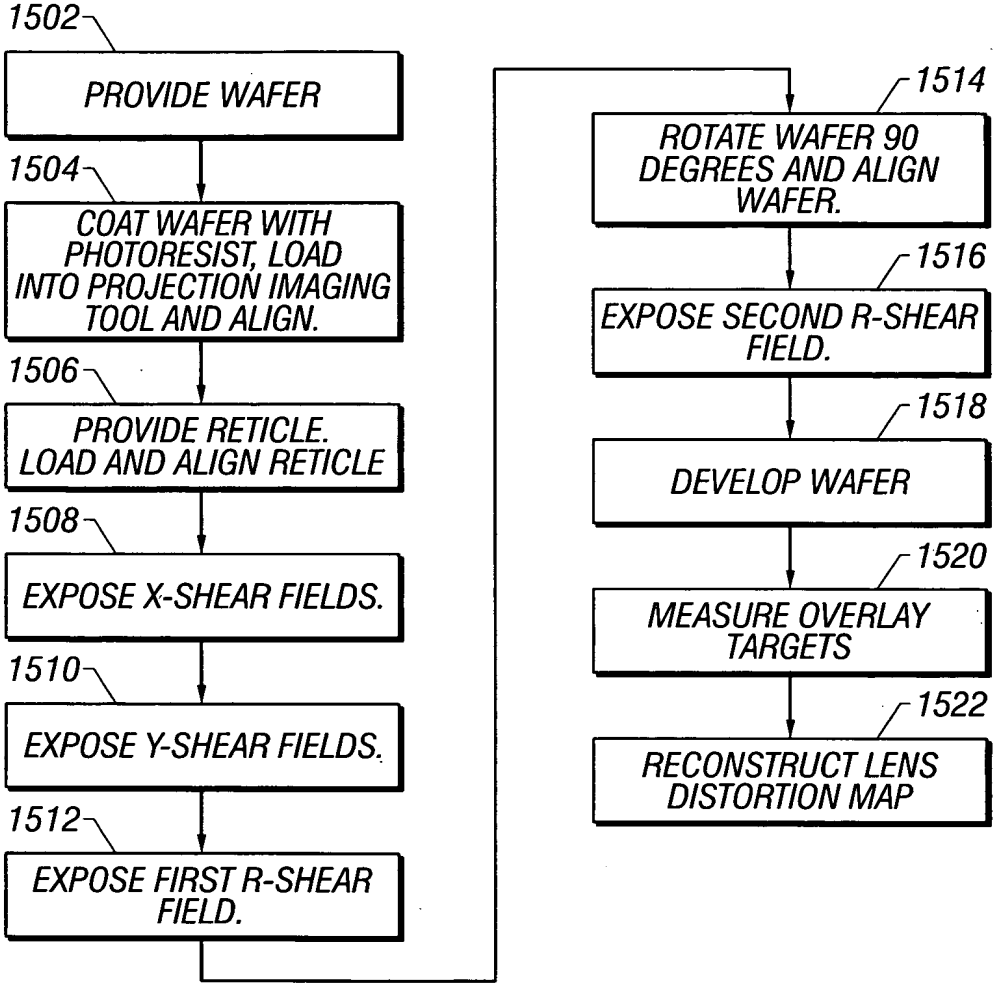


FIG. 15

Some components of overlay or placement error (Inter-field and Intra-field)

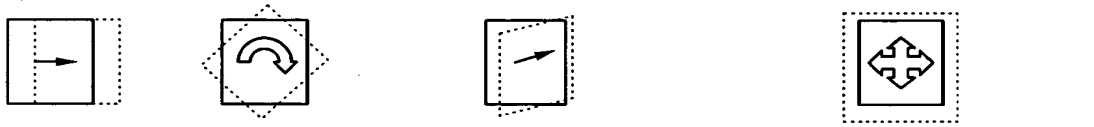


FIG. 16

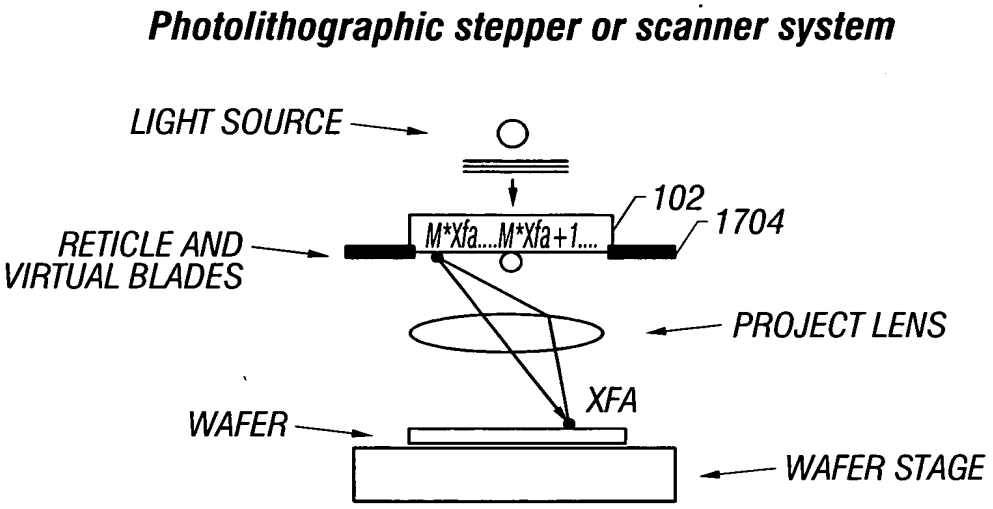


FIG. 17

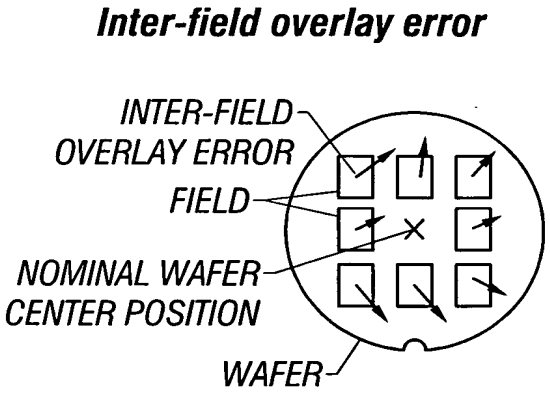


FIG. 18

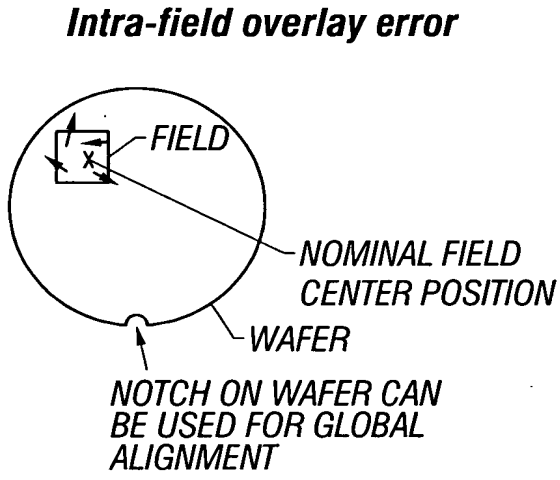


FIG. 19

New Overlay reticle

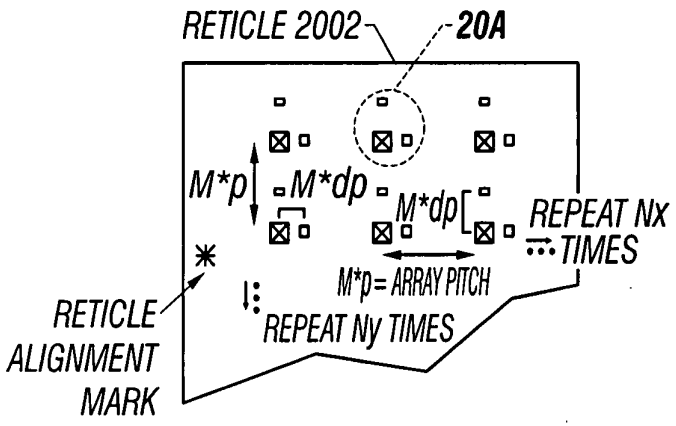


FIG. 20

Typical Detail of overlay group on New Overlay reticle (FIG. 20) as used on an M=4 lithographic projection tool. Dark=chrome, white=open

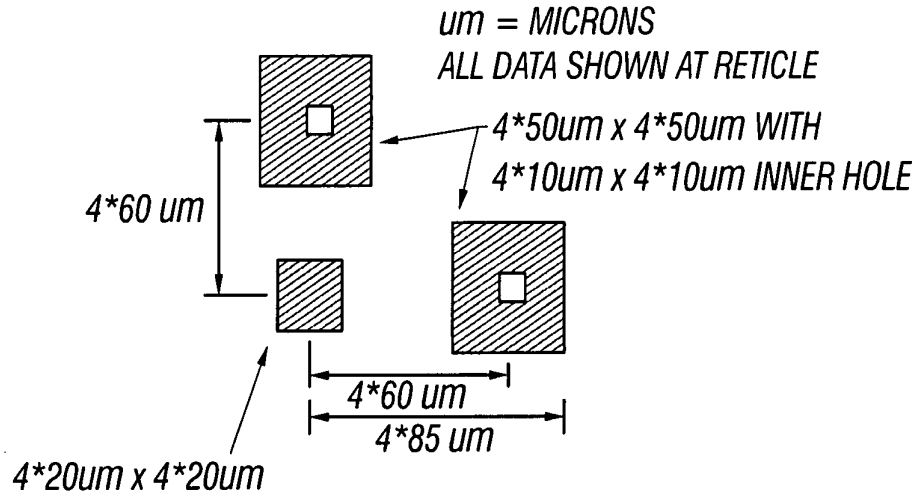


FIG. 20A

Heller Ehrman White & McAuliffe LLP
Title: "METHOD AND APPARATUS FOR SELF-REFERENCED PROJECTION LENS DISTORTION MAPPING"
Inventor(s): A. Smith et al.
Atty Docket No.: 38203-6080C
Application No.: 10/727,018 - Filed: 12/02/2003
8/31

Side view of reticle of FIG. 20

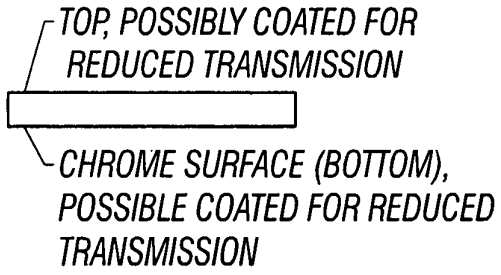


FIG. 20C

Intra-field indices projected onto the wafer

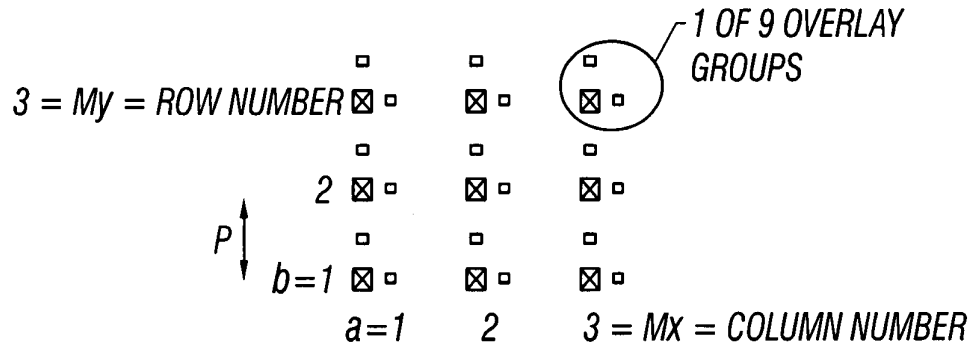


FIG. 20B

Example of prior art lens distortion test

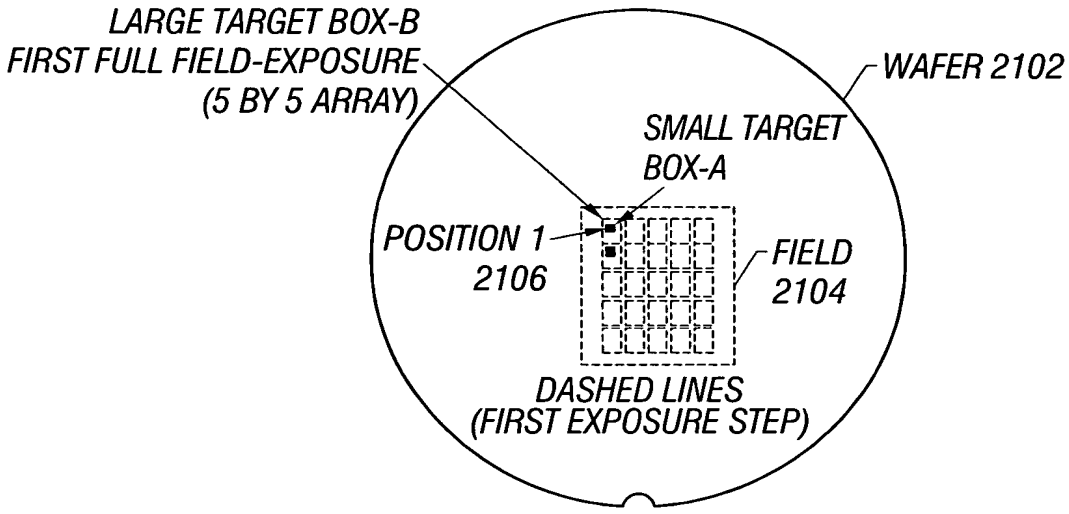


FIG. 21
(Prior Art)

Wafer with alignment marks at 0 and 90 degrees

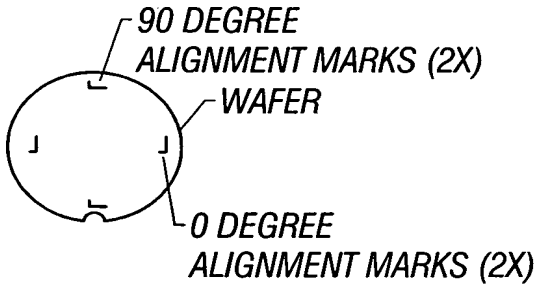


FIG. 22

Wafer after exposure of FIG. 20 overlay reticle at the 0 degree orientation

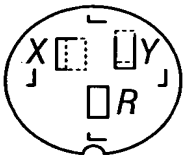


FIG. 23

Wafer after exposure of FIG. 20 overlay reticle at the 0 and 90 degree orientations (clockwise)

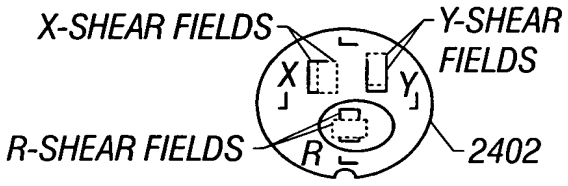


FIG. 24

Detail of R-shear pattern on wafer

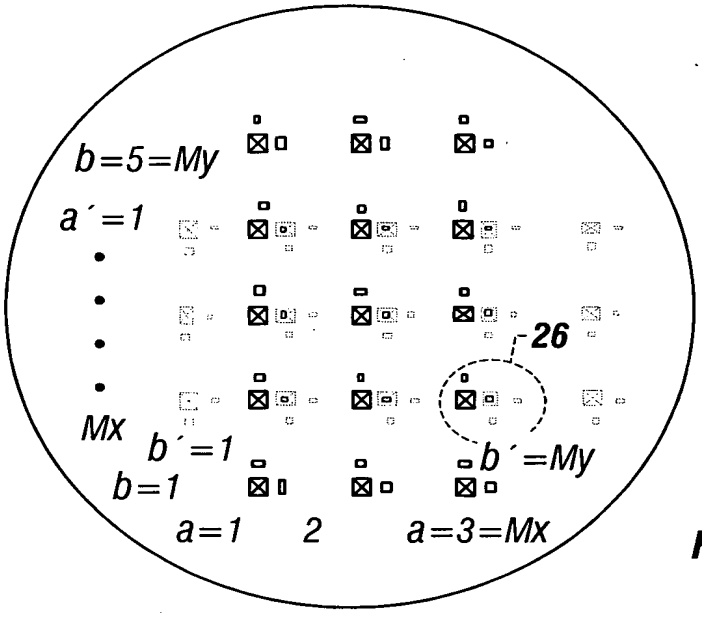


FIG. 25

Closeup of overlay groups for R-shear

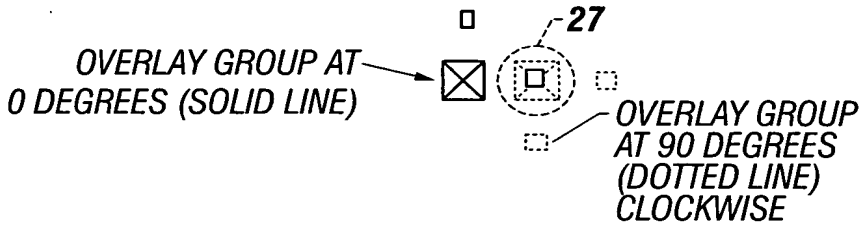


FIG. 26

Single Box-in-Box target.
dark = undeveloped photoresist
white = no photoresist

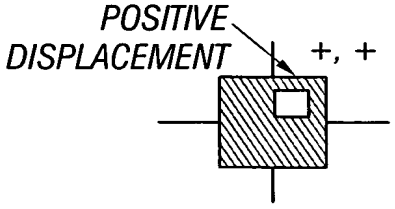


FIG. 27

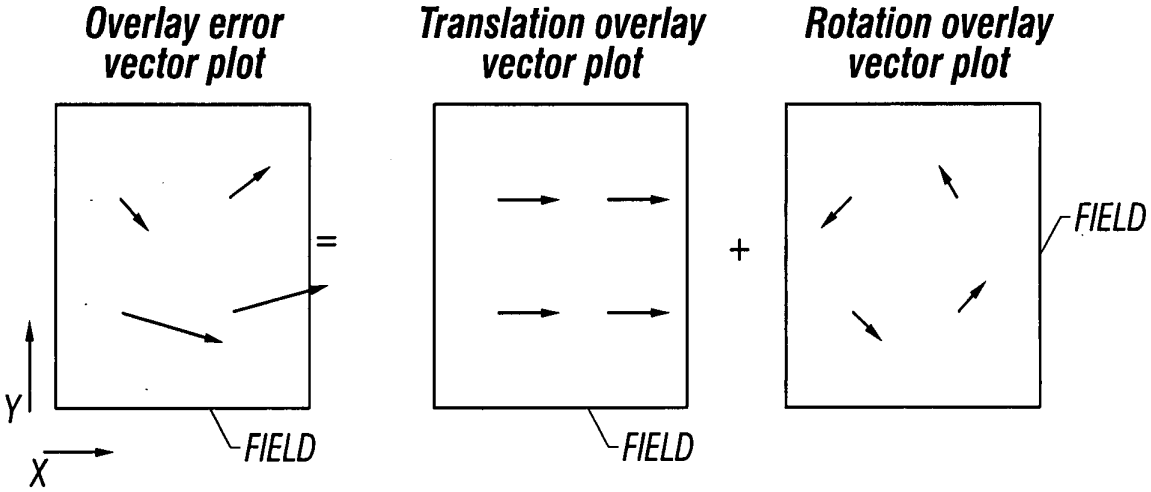
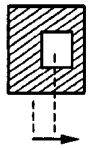


FIG. 28

FIG. 29

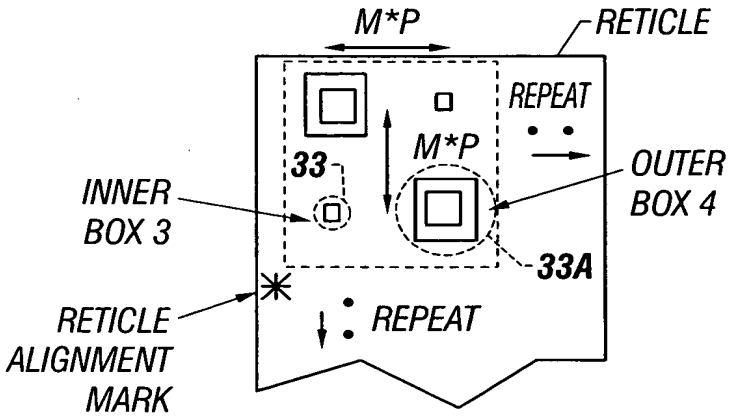
FIG. 30

Overlay measurement



THE VECTOR REPRESENTS THE ALIGNMENT OFFSET DISTANCE BETWEEN THE BOX-IN-BOX STRUCTURE

FIG. 31



Alternate embodiment overlay reticle

FIG. 32

Inner box 3 on reticle. Dark=chrome, white=open.

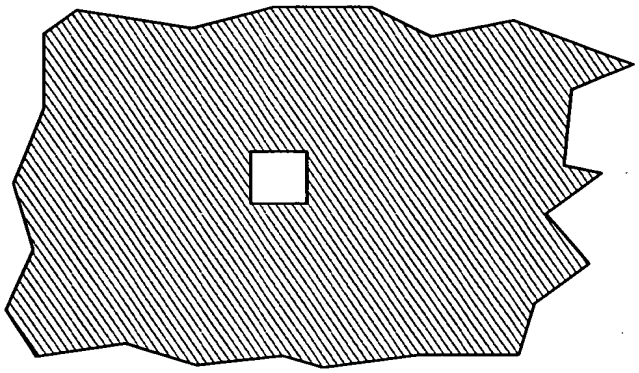
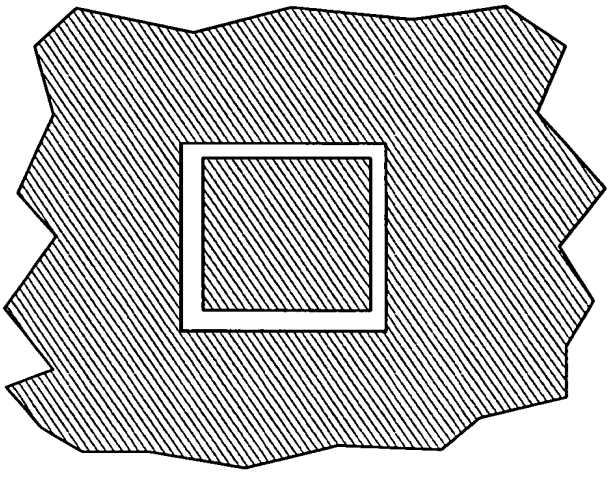


FIG. 33



Outer box 4 on reticle. Dark=chrome, white=open.

FIG. 33A

Process flow for the preferred embodiment for self-referencing lens distortion measurement.

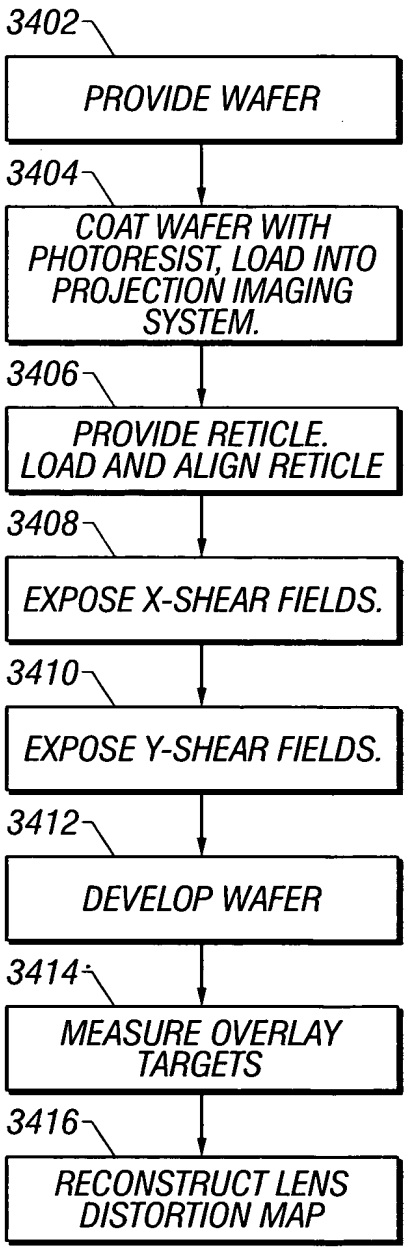


FIG. 34

Process flow for the alternate embodiment utilizing sub-Eo exposure doses on the wafer.

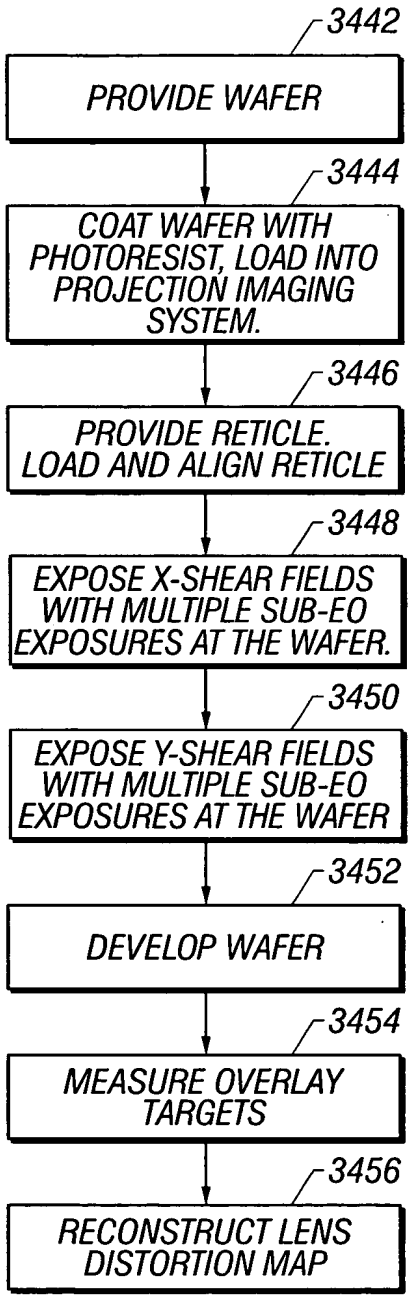


FIG. 34A

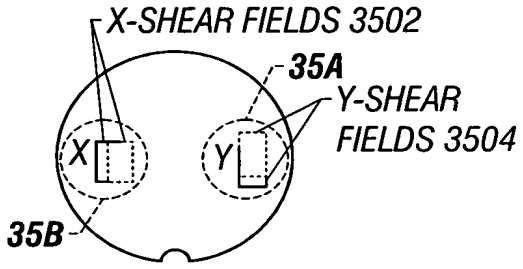


FIG. 35

Wafer after exposure of FIG. 20 overlay reticle for X and Y shears.

Detail of Y-shear for a 2 x 2 set of overlay groups

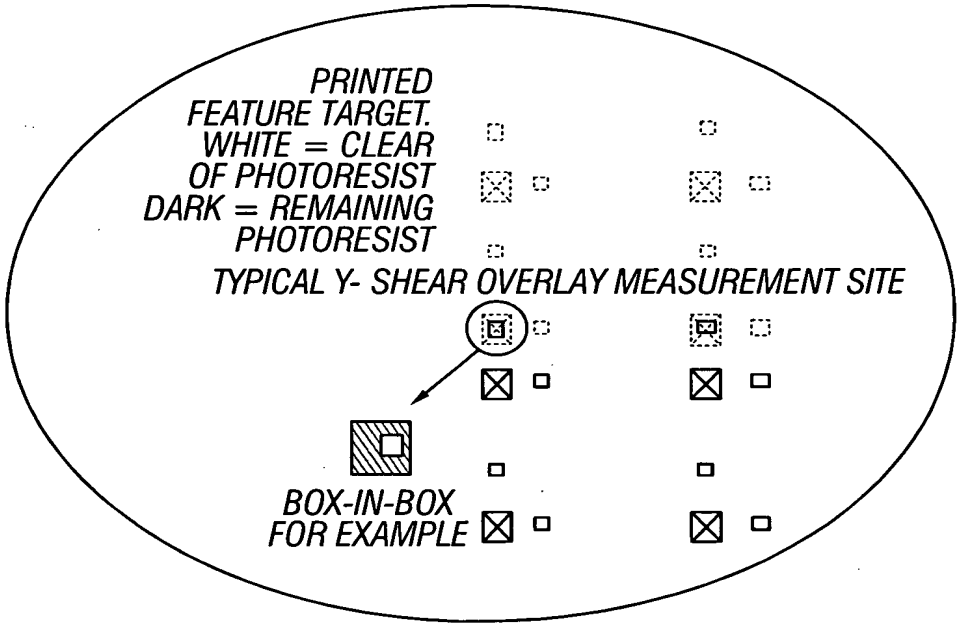


FIG. 35A

Detail of X-shear for a 2 x 2 set of overlay groups.

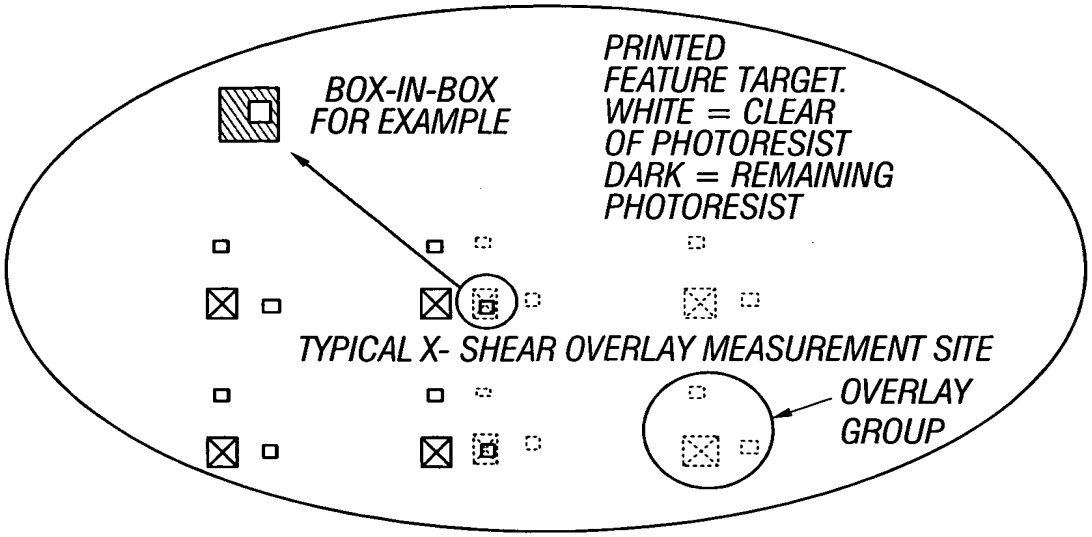


FIG. 35B

Final results of the method of this invention. Units=microns, (xf, yf) = intra-field location, (dxf, dyf) = intra-field distortion at point (xf, yf).

Machine id: DUVF11-02

Xf	yf	dxf	dyf
-10000.000	-10000.000	-0.139	0.044
-8000.000	-10000.000	0.223	-0.233
-6000.000	-10000.000	0.498	0.004
.	.	.	.
.	.	.	.
.	.	.	.
10000.000	10000.000	0.099	-0.188

FIG. 36

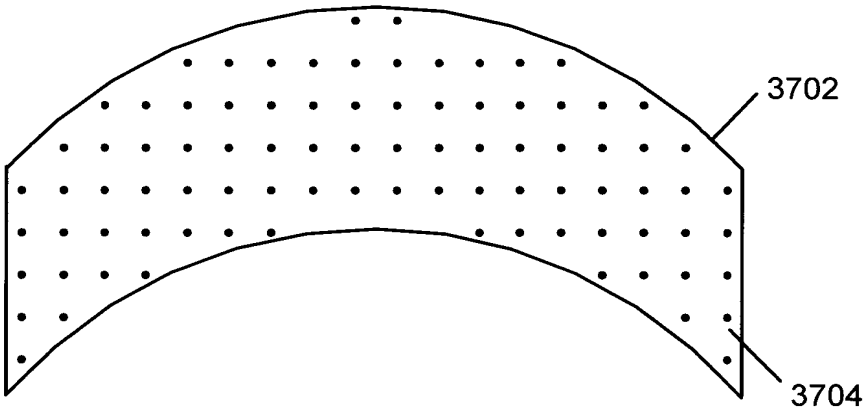


Figure 37

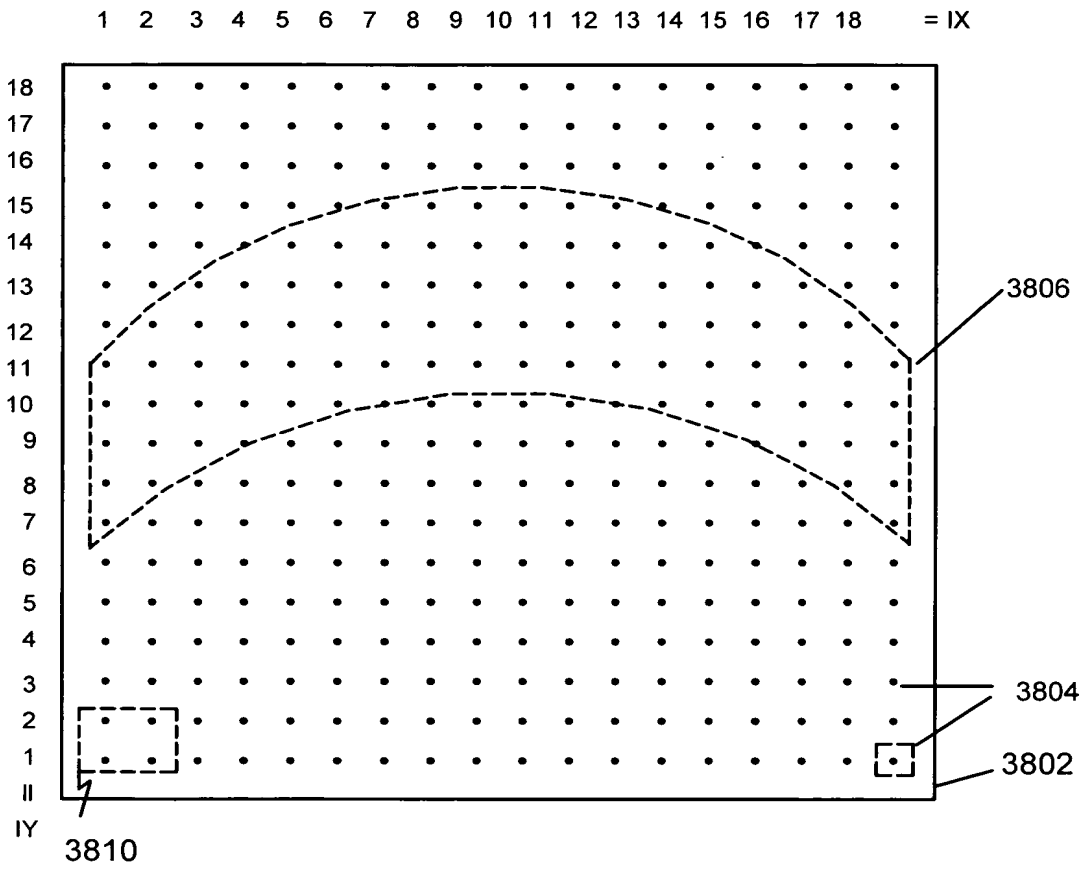
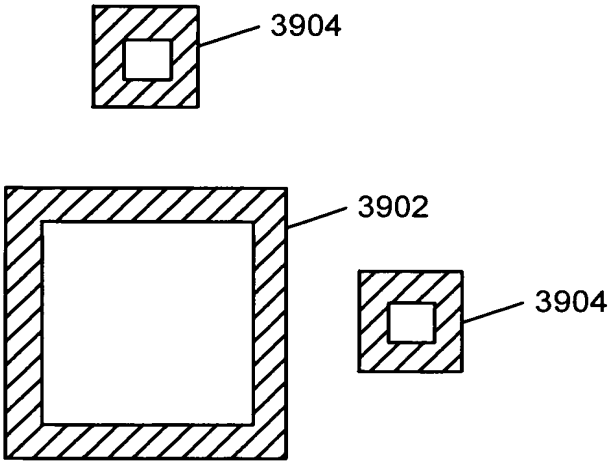
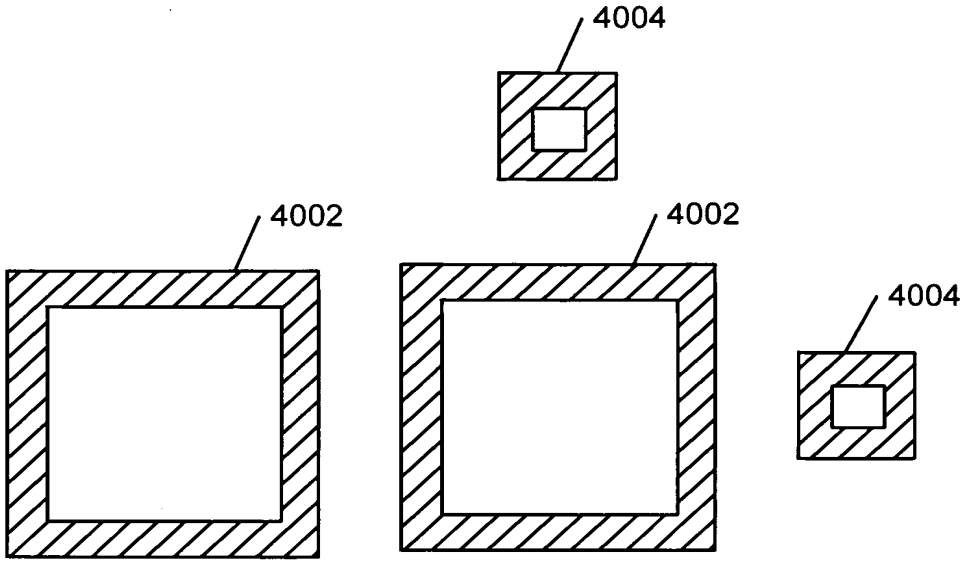

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 = IX
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
II
IY
3806
3804
3802
3810

Figure 38



18.1

Figure 39



18,1

Figure 40

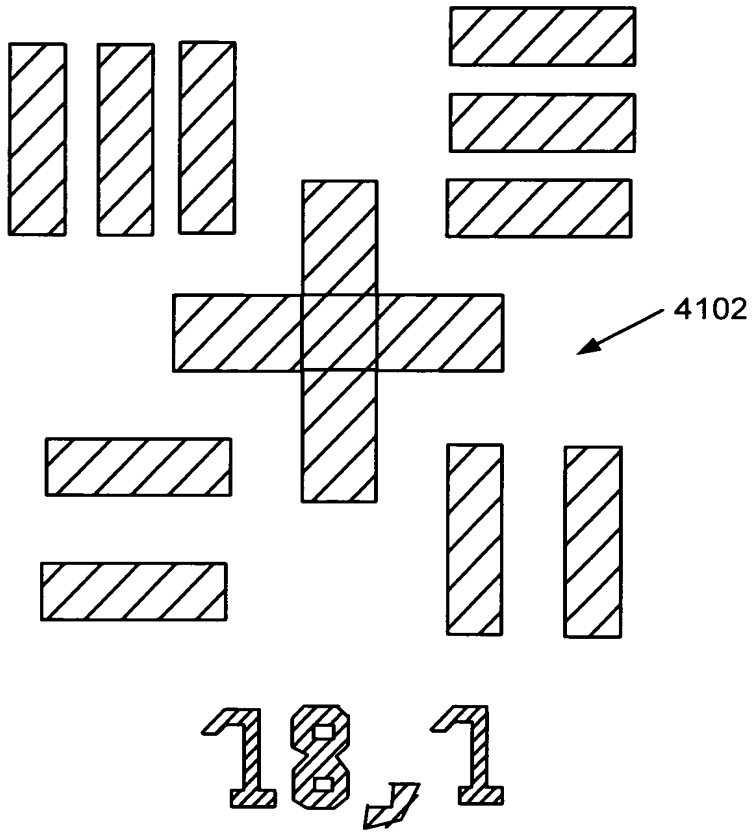


Figure 41

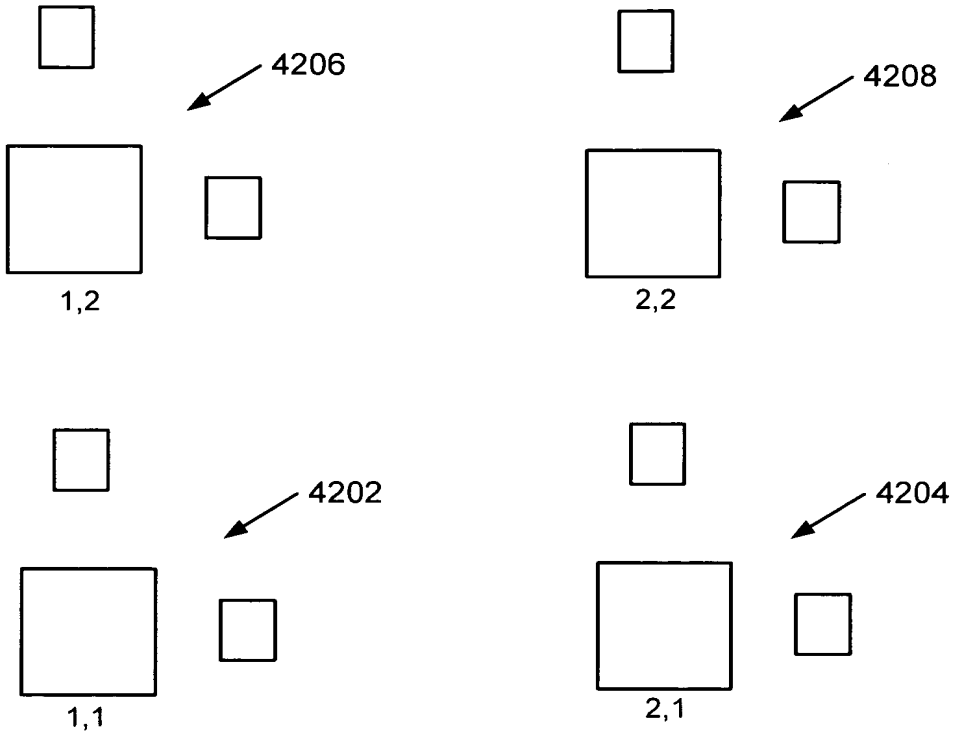


Figure 42

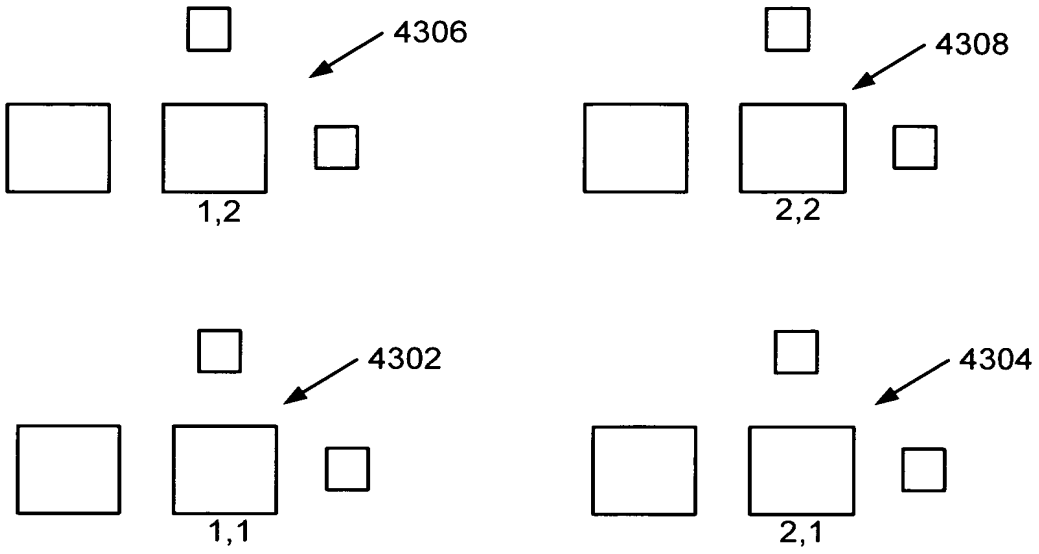


Figure 43

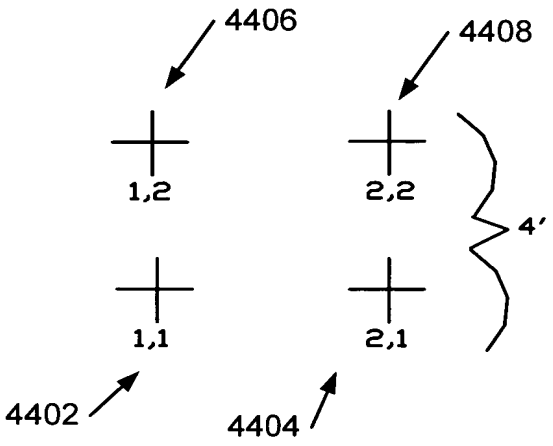


Figure 44

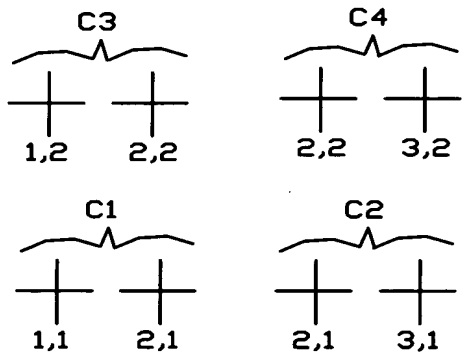


Figure 45

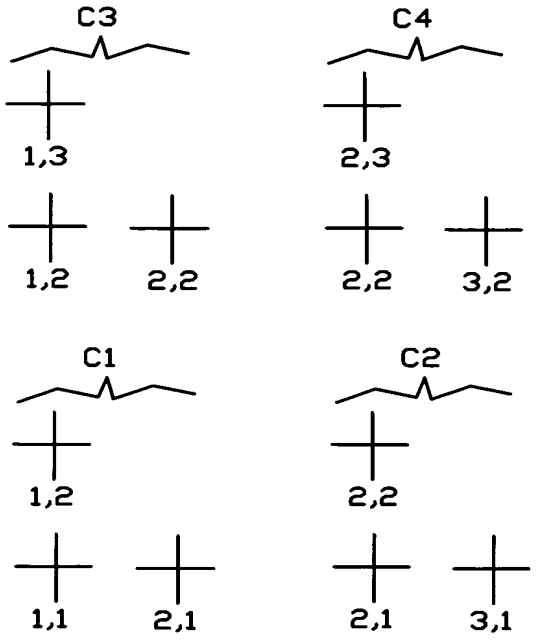


Figure 46

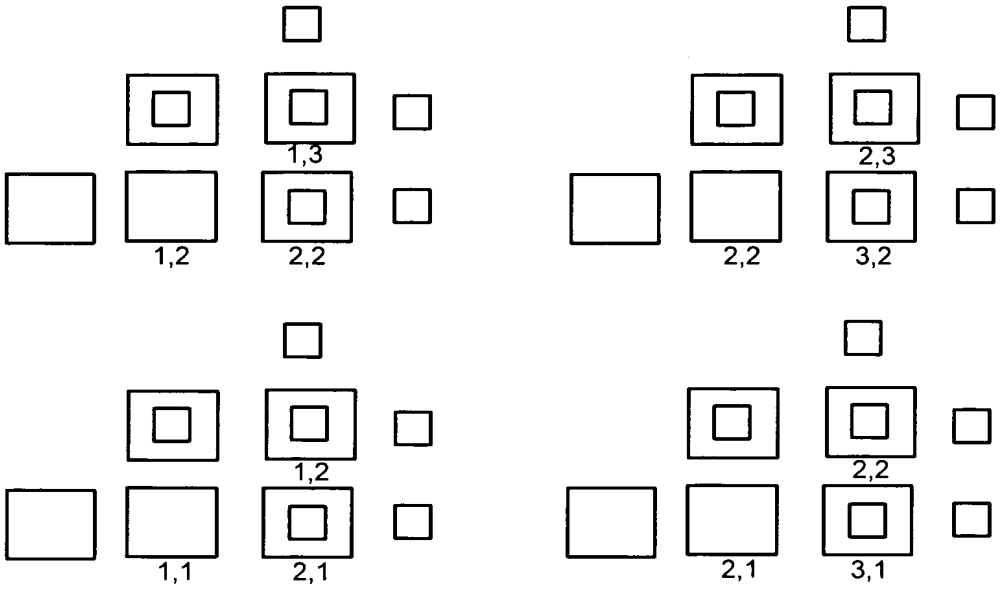


Figure 47

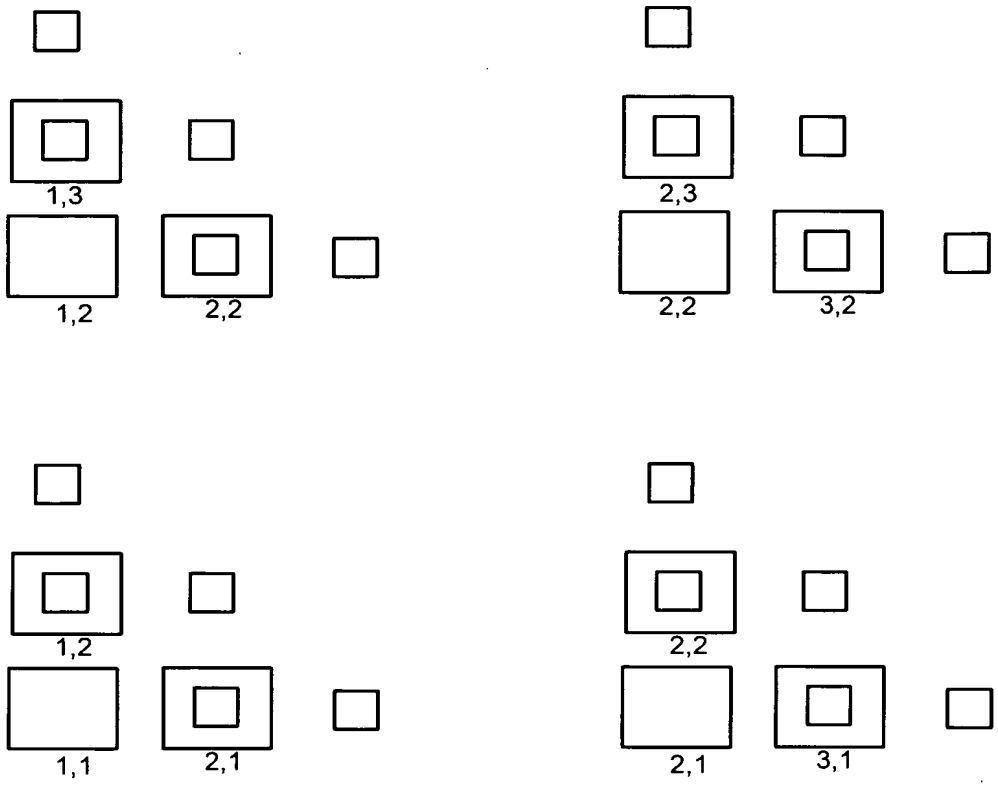


Figure 48

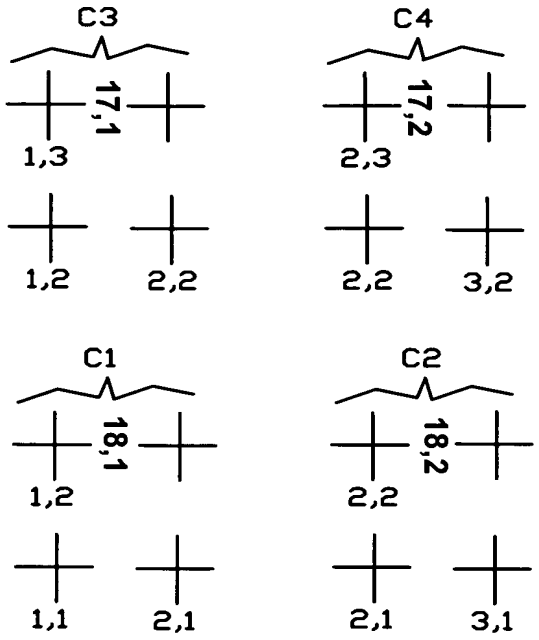


Figure 49

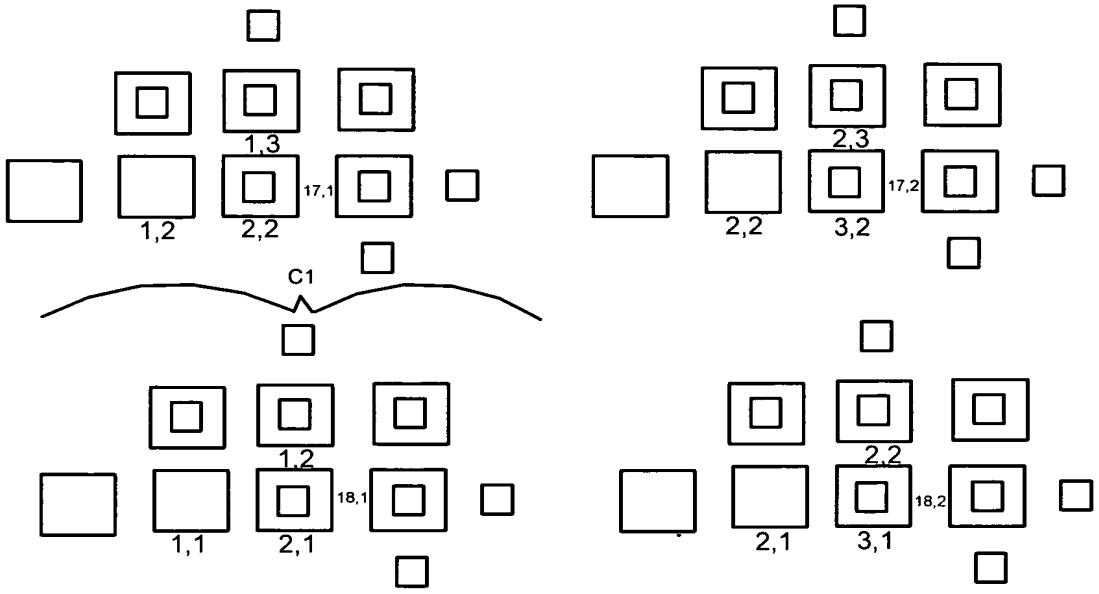


Figure 50

Machine id: DUVF11-03

xf	yf	a2	a3
-10000	-10000	-0.15	0.06
-8000	-10000	-0.17	-0.42
-6000	-10000	-0.38	-0.01
-	-		
-	-		
-	-		
-	-		
-	-		
10000	10000	0.11	-0.08

Figure 51
Final result for computation of x and y tilt.
(xf,yf) = intrafield location in microns
(a2, a3) = (x,y) tilt in radians